K4E Reproduction and Inheritance: Depth and Practice

AQA AQA KS3 Biology · Calculator allowed · about 90 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A student writes: "Sexual reproduction always involves two parents and makes offspring that are genetically different." State whether both parts of this sentence are true or false and correct any part that is false.

(2)

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2 In human reproduction, what are the names of the male gamete and the female gamete? Give both names.

(1)

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3 Describe two differences between sperm cells and egg cells that help their roles in reproduction.

(3)

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4 Explain the difference between pollination and fertilisation in flowering plants.

(2)

5 Put these stages of a flowering plant life cycle in the correct order: 1) seed germinates, 2) pollen lands on stigma, 3) seed forms, 4) pollen tube grows, 5) ovule is fertilised. Write the order as a list of numbers corresponding to the stages above (1 to 5).

(5)

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6 Some plants reproduce asexually using runners (stems that grow along the ground). Suggest one advantage and one disadvantage of asexual reproduction for these plants.

(2)

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7 A class investigates inheritance by crossing fast-growing pea plants (trait F) with slow-growing pea plants (trait f). Fast-growing plants are tall and have genotype T T or T t, slow-growing are short and have genotype t t. The teacher crosses a true-breeding tall plant (T T) with a true-breeding short plant (t t) and all offspring are tall. The class then self-pollinates one of these tall offspring (genotype T t) and gets a second generation with 3 tall : 1 short ratio. Explain what these results suggest about the inheritance of height in these peas.

(4)

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8 Name the male and female reproductive parts of a flower.

(a) Name the male reproductive part. **(1)**

(b) Name the female reproductive part. **(1)**

9 Define the terms gene, chromosome and DNA.

(a) Gene. **(1)**

(b) Chromosome. **(1)**

(c) DNA. **(1)**

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10 In pea plants, purple flower colour (allele P) is dominant over white flower colour (allele p). Two heterozygous purple-flowered plants (genotype Pp) are crossed.

(a) State the possible gametes each parent plant can produce. **(1)**

(b) Using a Punnett square (or listing all combinations), state the genotype ratio of the offspring. **(2)**

(c) State the phenotype ratio of the offspring. **(1)**

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11 Explain why offspring produced by sexual reproduction show variation, but offspring produced by asexual reproduction normally do not.

(2)

12 A fetus develops inside its mother's uterus for around nine months.

(a) Name the organ that allows food, oxygen and waste to be exchanged between mother and fetus. **(1)**

(b) Explain how substances pass between the mother's blood and the fetus's blood at this organ. **(1)**

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13 Which structure protects and cushions the fetus inside the uterus?

- ☐ A) Placenta
- ☐ B) Amniotic fluid
- ☐ C) Umbilical cord
- ☐ D) Cervix

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14 Continuous variation (e.g. height) and discontinuous variation (e.g. blood group) are both seen within a species. Explain the difference between them, giving one further example of each that is not given above.

(3)

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15 Give two factors, other than genes, that can cause variation between individuals of the same species.

(2)

16 Farmers use selective breeding to produce cows that give more milk.

(a) Describe the process of selective breeding. **(2)**

(b) Suggest one risk of using selective breeding. **(1)**

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17 Name the type of reproduction that produces offspring genetically identical to a single parent, and give one example of an organism that reproduces this way.

(2)

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18 A farmer selectively breeds sheep for thick wool over many generations, so most of the flock becomes closely related. Explain why this could reduce the flock's ability to survive a new disease outbreak, compared with a more genetically varied flock.

(3)

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19 Identical (monozygotic) twins have exactly the same genes, but are not always identical in appearance. Explain why.

(2)

20 State the number of chromosomes found in a normal human body cell, and the number found in a human gamete (sperm or egg cell).

(a) Number of chromosomes in a normal human body cell. **(1)**

(b) Number of chromosomes in a human gamete. **(1)**

Mark scheme · K4E Reproduction and Inheritance: Depth and Practice

Question 1

- **B1** first part true: sexual reproduction usually involves two parents (two gametes from two parents), cao
- **B1** second part true: offspring are usually genetically different from their parents, leading to variation, cao
- Answer: **Both parts true; sexual reproduction usually involves two parents and produces offspring that are genetically different.**

Question 2

- **B1** sperm and egg (ovum) cao
- Answer: **Sperm and egg (ovum)**

Question 3

- **M1** one difference: sperm are small and motile with a tail, egg is larger and non-motile, oe
- **M1** second difference: egg contains more cytoplasm and food stores while sperm has little cytoplasm and mainly DNA, oe
- **A1** both differences linked to roles: sperm swims to reach egg; egg supports early embryo, cao
- Answer: **Sperm are small and have a tail to swim while eggs are large and do not swim; eggs contain more cytoplasm and food stores to support the early embryo while sperm carry mainly DNA.**

Question 4

- **M1** pollination = transfer of pollen to the stigma or another part of a flower stated
- **A1** fertilisation = fusion of the male gamete from pollen with the female gamete in the ovule (joining of nuclei) cao
- Answer: **Pollination is the transfer of pollen to a stigma; fertilisation is the fusion of the male gamete with the female gamete inside the ovule.**

Question 5

- **M1** correct first two steps: 2 then 4 stated
- **M1** correct next step: 5 stated
- **M1** correct following step: 3 stated
- **M1** correct final step: 1 stated
- **A1** full correct order given as 2,4,5,3,1 cao
- Answer: **2, 4, 5, 3, 1**

Question 6

- **M1** advantage: rapid production of many identical offspring or colonisation of area stated, oe
- **M1** disadvantage: low genetic variation so vulnerable to disease or environmental change, oe
- Answer: **Advantage: fast production of identical offspring useful in stable conditions. Disadvantage: low genetic variation makes the population vulnerable to disease or environmental change.**

Question 7

- **M1** recognition that tall is dominant and short is recessive (T dominant, t recessive) stated
- **M1** first cross gives all tall offspring because parents were TT x tt producing only Tt
- **M1** self pollination of Tt gives genotype ratio 1 TT : 2 Tt : 1 tt which leads to 3 tall : 1 short phenotype
- **A1** conclusion linking the observed 3:1 ratio to dominant/recessive inheritance and heterozygous parents, cao
- Answer: **Tall is dominant and short is recessive. The TT x tt cross produced all Tt offspring (all tall). Self-pollinating Tt gives genotypes 1 TT : 2 Tt : 1 tt so the phenotypes are 3 tall : 1 short, supporting dominant/recessive inheritance.**

Question 8

- (a) **B1** stamen (anther and filament), oe
- (a) Answer: **Stamen (made up of the anther and filament)**
- (b) **B1** carpel/pistil (stigma, style and ovary), oe
- (b) Answer: **Carpel (made up of the stigma, style and ovary)**

Question 9

- (a) **B1** a short section of DNA that codes for a characteristic/protein, oe
- (a) Answer: **A gene is a short section of DNA that codes for a particular characteristic (or protein)**
- (b) **B1** a long coiled thread of DNA made up of many genes, found in the nucleus, oe
- (b) Answer: **A chromosome is a long, coiled thread of DNA made up of many genes, found in the nucleus**
- (c) **B1** the molecule that carries genetic information/instructions in cells, oe
- (c) Answer: **DNA is the molecule that carries the genetic instructions used in the growth and functioning of living things**

Question 10

- (a) **B1** P and p cao
- (a) Answer: **P and p**
- (b) **M1** combinations PP, Pp, Pp, pp shown or listed
- (b) **A1** 1 PP : 2 Pp : 1 pp cao
- (b) Answer: **1 PP : 2 Pp : 1 pp**
- (c) **B1** 3 purple : 1 white cao
- (c) Answer: **3 purple : 1 white**

Question 11

- **M1** sexual reproduction combines genetic material (alleles) from two parents, producing new combinations of genes, oe
- **A1** asexual reproduction involves only one parent, so offspring are genetically identical to that parent (clones), oe
- Answer: **Sexual reproduction mixes genetic material from two parents, creating new combinations of alleles in the offspring, so they vary. Asexual reproduction involves only one parent and no mixing of genes, so the offspring are genetically identical clones of that parent.**

Question 12

- (a) **B1** placenta cao
- (a) Answer: **Placenta**
- (b) **B1** substances diffuse across the placenta; the mother's and fetus's blood do not mix, oe
- (b) Answer: **Oxygen and nutrients diffuse from the mother's blood into the fetus's blood, and waste products diffuse the other way, across the placenta, without the two blood supplies mixing**

Question 13

- **B1** amniotic fluid cao (B)
- Answer: **Amniotic fluid**

Question 14

- **M1** continuous variation: characteristics can take any value across a range, often with no clear categories, oe
- **M1** discontinuous variation: characteristics fall into a small number of distinct categories with no in-between values, oe
- **A1** one valid new example of each given, e.g. continuous - hand span/foot length; discontinuous - ability to roll tongue/earlobe attachment
- Answer: **Continuous variation can take any value across a range (e.g. hand span). Discontinuous variation falls into a small number of distinct categories with no values in between (e.g. being able to roll your tongue or not).**

Question 15

- **B1** one environmental factor, e.g. diet/nutrition
- **B1** second environmental factor, e.g. exercise, climate, amount of sunlight, disease, oe
- Answer: **Environmental factors such as diet and amount of exercise can both cause variation between individuals of the same species**

Question 16

- (a) **M1** select parents with the desired characteristic (highest milk yield) and breed them together
- (a) **A1** repeat over many generations, each time selecting offspring with the best milk yield, oe
- (a) Answer: **Farmers choose cows with the highest milk yield and breed them together. They repeat this over many generations, each time selecting the offspring with the best milk yield, until most of the herd shows the desired characteristic.**
- (b) **B1** reduced genetic variation, making the population more vulnerable to disease or environmental change, oe
- (b) Answer: **It reduces genetic variation in the population, making it more vulnerable to disease or environmental change**

Question 17

- **B1** asexual reproduction cao
- **B1** valid example, e.g. bacteria, strawberry plants (runners), spider plants, oe
- Answer: **Asexual reproduction, e.g. a strawberry plant producing new plants from runners**

Question 18

- **M1** selective breeding reduces genetic variation, so most sheep share very similar alleles
- **M1** if a new disease appears, few or no sheep may happen to have alleles giving resistance
- **A1** so a much larger proportion of the flock could become ill or die than in a genetically varied population, where some individuals are more likely to be resistant
- Answer: **Selective breeding reduces genetic variation, so nearly all the sheep are genetically similar. If a new disease appears, few or none may have alleles giving resistance, so a much larger proportion of the flock could die than in a genetically varied population, where some individuals are more likely to survive and pass on resistance.**

Question 19

- **M1** environmental factors (e.g. diet, exercise, injury, lifestyle) differ between the twins, oe
- **A1** these environmental differences affect how the same genes are expressed (phenotype), so the twins can look different despite identical genotypes, oe
- Answer: **Even though identical twins have the same genotype, differences in their environment (such as diet, exercise or lifestyle) affect how their genes are expressed, so their phenotypes (appearance) can differ.**

Question 20

- (a) **B1** 46 (23 pairs) cao
- (a) Answer: **46 (23 pairs)**
- (b) **B1** 23 cao
- (b) Answer: **23**